Upper Paleocene – Lower Eocene nannofossils from the Gosau Group of Gams/Styria (Austria)

Hans EGGER[1], Michael WAGREICH[2]

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Abstract: Within the Gams area a Paleogene turbidite succession (zones NP6 – NP10) is overlain by an interval of marls with few sandstone layers. The marls yielded nannofossil assemblages, which prove an Early Eocene age for the youngest known deposits of the Gosau Group of Gams. Marker species include *Discoaster lodoensis* and *Tribrachiatus orthostylus* (Type B) which indicate calcareous nannofossil standard Zone NP12.

Zusammenfassung: Im Gebiet von Gams wird eine paläogene Turbiditabfolge (Zone NP6 – NP10) der Gosau-Gruppe von einem pelitreichem Abschnitt mit wenigen Sandsteinlagen überlagert. Die Pelite lieferten eine Nannofossilvergesellschaftung, die ein frühes Eozänalter für die jüngsten bekannten Sedimente der Gosau-Gruppe von Gams anzeigt. Nannofossilleitformen wie *Discoaster lodoensis* und *Tribrachiatus orthostylus* (Type B) belegen die Nannofossilstandardzone NP12.

Keywords: Paleocene, Early Eocene, Calcareous Nannofossils, Gosau Group, Gams

Contents

1. INTRODUCTION

Paleogene deposits of the Northern Calcareous Alps are known from several outcrop areas of the Gosau Group (for a review see WAGREICH & FAUPL, 1994; FAUPL & WAGREICH, 2000; WAGREICH, this volume). However, until now detailed sedimentological and paleontological investigations of the Paleogene deposits are largely lacking. Cretaceous/Paleogene-boundary intervals were studied in the Elendgraben section near Gosau

[1] Geological Survey of Austria, Rasumofskygasse 23, 1031 Vienna, E-mail: eggjoh@cc.geolba.ac.at
[2] Institute of Geology, University of Vienna, Althanstrasse 14, 1090 Vienna, E-mail: michael.wagreich@univie.ac.at

(PREISINGER et al., 1986) and in the Knappengraben section near Gams (LAHODYNSKY, 1988). In addition, a report on volcanic ash layers in the Upper Paleocene of the Untersberg area was published by EGGER et al. (1996). In the area of Gams Paleogene strata were discovered already by WICHER (1956). A latest Paleocene to Early Eocene age was assigned to the youngest deposits of this area by KOLLMANN (1963, 1964), based on planktic foraminifera and nummulites. In the current paper we present the first data on nannofossil assemblages from the Upper Paleocene to Lower Eocene of the Gams area.

2. GEOLOGICAL SETTING AND LITHOSTRATIGRAPHY IN THE GAMS AREA

The deposits of the Gosau Group of the Northern Calcareous Alps comprise a sedimentary megacycle unconformably overlying folded and thrusted Permian to Lower Cretaceous successions (e.g., WAGREICH & FAUPL, 1994). Basin formation was attributed to extension after mid-Cretaceous thrusting and subsequent rapid subsidence due to subduction processes (WAGREICH, 1993, 1995).

The Gosau Group of the Gams area ("Gams basin" of KOLLMANN & SUMMESBERGER, 1982) comprises sedimentary successions of two outcrop areas: in the western part up to 1000 m of terrestrial to shallow-marine strata of the lower Gosau Subgroup (Upper Turonian – Santonian) can be found (KOLLMANN & SUMMESBERGER, 1982; SUMMESBERGER & KENNEDY, 1996; SIEGL-FARKAS & WAGREICH, 1997). In the eastern outcrop area (Gamsforst – Krautgraben – Krimpenbach), deep-water sediments of the upper Gosau Subgroup rest unconformably upon a thin Santonian/Campanian succession (SUMMESBERGER et al., 1999; EGGER et al., 2000a). The upper Gosau Subgroup comprises turbiditic and hemipelagic strata of Campanian to Early Eocene age (KOLLMANN, 1964; LAHODYNSKY, 1988).

The lithostratigraphic subdivision of the upper Gosau Group in the area of Gams is still rather poorly defined. Paleocene to Eocene deposits are assigned to the Nierental Formation (WAGREICH & KRENMAYR, 1993; KRENMAYR, 1996, 1999) and the Zwieselalm Formation. The Nierental Formation comprises mainly (hemi)pelagic marls and marly limestones, including slump deposits, deep-water debris flow deposits and minor turbidite layers. The Zwieselalm Formation is dominated by turbidites including thick, coarse-grained breccia layers and olistostromes. From west to east the gradual contact of the Nierental Formation to the Zwieselalm Formation shows a significant diachroneity, becoming younger to the east (WAGREICH & KRENMAYR, 1993).

Lower Eocene strata are characterized by marls and mudstones with minor sandy turbidite layers ("Tonmergelserie" of KOLLMANN, 1964:117), which we provisionally include into the Zwieselalm Formation. Eocene marls are restricted to southeastern outcrop areas of the Gosau Group of Gams, where Triassic dolomites and deposits of the lower Gosau Subgroup of the Rabenmauer slice (KOLLMANN, 1964; SUMMESBERGER et al., 1999) overthrust the topmost layers of the upper Gosau Subgroup of the Gams "basin".

Samples were mainly collected at outcrops along the forest road to the Eichmayralm, 700 m E Pretschuhalm, and a small southern tributary of the Gamsbach, 300 m SSW of Grafenalm (Fig. 1). The outcrops in the creek provide a composite section through the Paleocene to Lower Eocene; only a few spot samples were taken from the lower, northern part of the creek. We concentrated our sampling on the stratigraphically highest part of the section along the forest road (see inset in Fig. 1). Samples were also

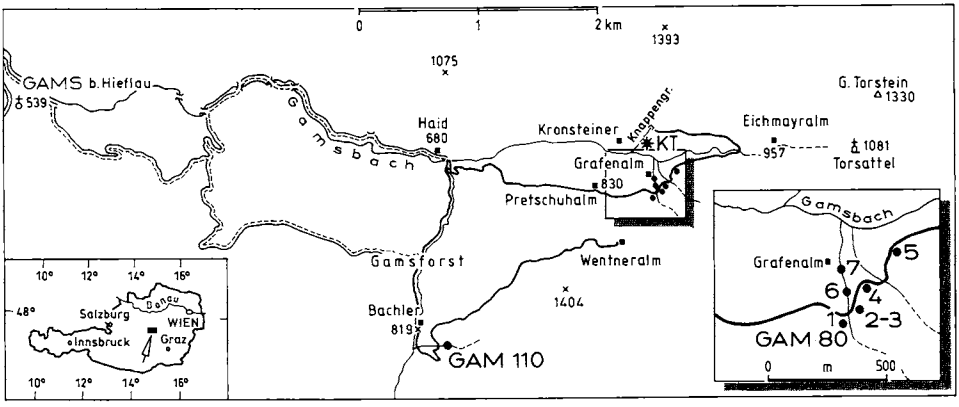


Fig. 1: Sketch map of the Gams area, showing sample locations mentioned in the text. KT marks the location of the Cretaceous – Paleogene boundary site of the Knappengraben.

taken 350 m SW of the farm house Bachler, where Eocene marls crop out in a tectonic window between red conglomerates of the lower Gosau Subgroup (WAGREICH, 1994).

3. NANNOFOSSIL ASSEMBLAGES

Smear slides were prepared and studied with the light-microscope at a magnification of 1000x. Calcareous nannoplankton is common and well to moderately preserved, in particular, discoasterids are often corroded. Redeposition of Cretaceous species is always less than 1% and indicates erosion of Campanian and Maastrichtian strata during the Paleogene (*Broinsonia parca parca* (STRADNER), *Arkhangelskiella cymbiformis* VEKSHINA, *Prediscospaera cretacea* (ARKHANGELSKY), *Micula decussata* VEKSHINA, *Watznaueria barnesae* (BLACK)). Specimens of *Cruciplacolithus tenuis* (STRADNER) and *Fasciculithus tympaniformis* HAY & MOHLER in the nannoplankton assemblages of Subzone NP10c and of *Tribrachiatus bramlettei* (BRÖNNIMANN & STRADNER) in Zone NP11 indicate a reworking of Paleogene species as well. All samples display abundant species of the genus *Ericsonia* and other small coccoliths which are not described in detail here. We concentrate on species important for stratigraphic correlations using the zonal scheme of MARTINI (1971) and chronostratigraphic correlations by BERGGREN et al. (1995) and AUBRY (1996) (Fig. 2).

The oldest sample (GAM80/5; Fig. 1) can be attributed to Zone NP6. It contains common species of *Heliolithus kleinpelli* SULLIVAN and *Fasciculithus tympaniformis* whereas species of the genus *Discoaster* are lacking totally. *Cruciplacolithus latipons* ROMEIN, *Toweius eminens* (BRAMLETTE & SULLIVAN), *Neochiastozygus perfectus* PERCH-NIELSEN, and *Chiasmolithus consuetus* (BRAMLETTE & SULLIVAN) are other species of stratigraphic significance.

No samples were taken documenting Zones NP7, NP8 and NP9 due to poor outcrops. However, the upper part of Zone NP9 and the lower part of Zone NP10 were already discovered in a previous sampling survey west of Kronsteiner (outcrop 106 of

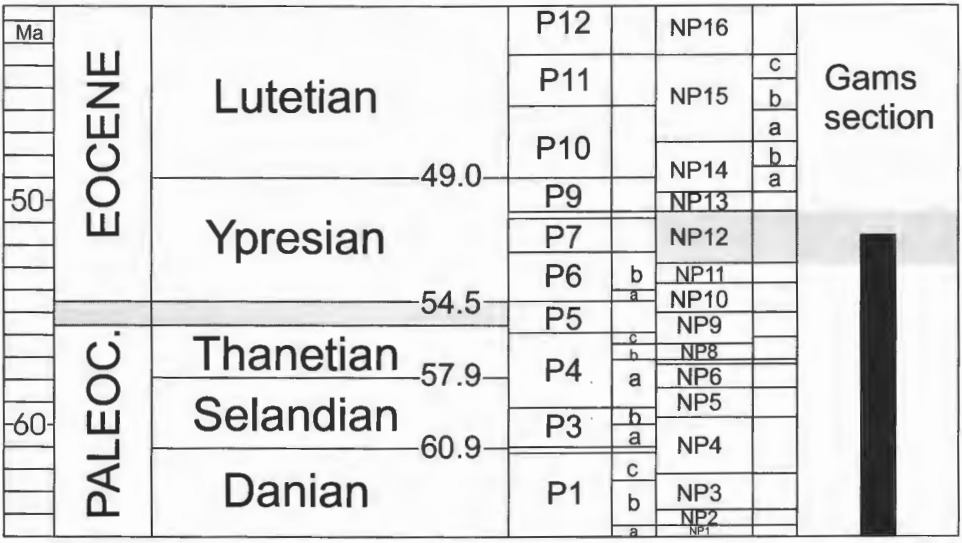
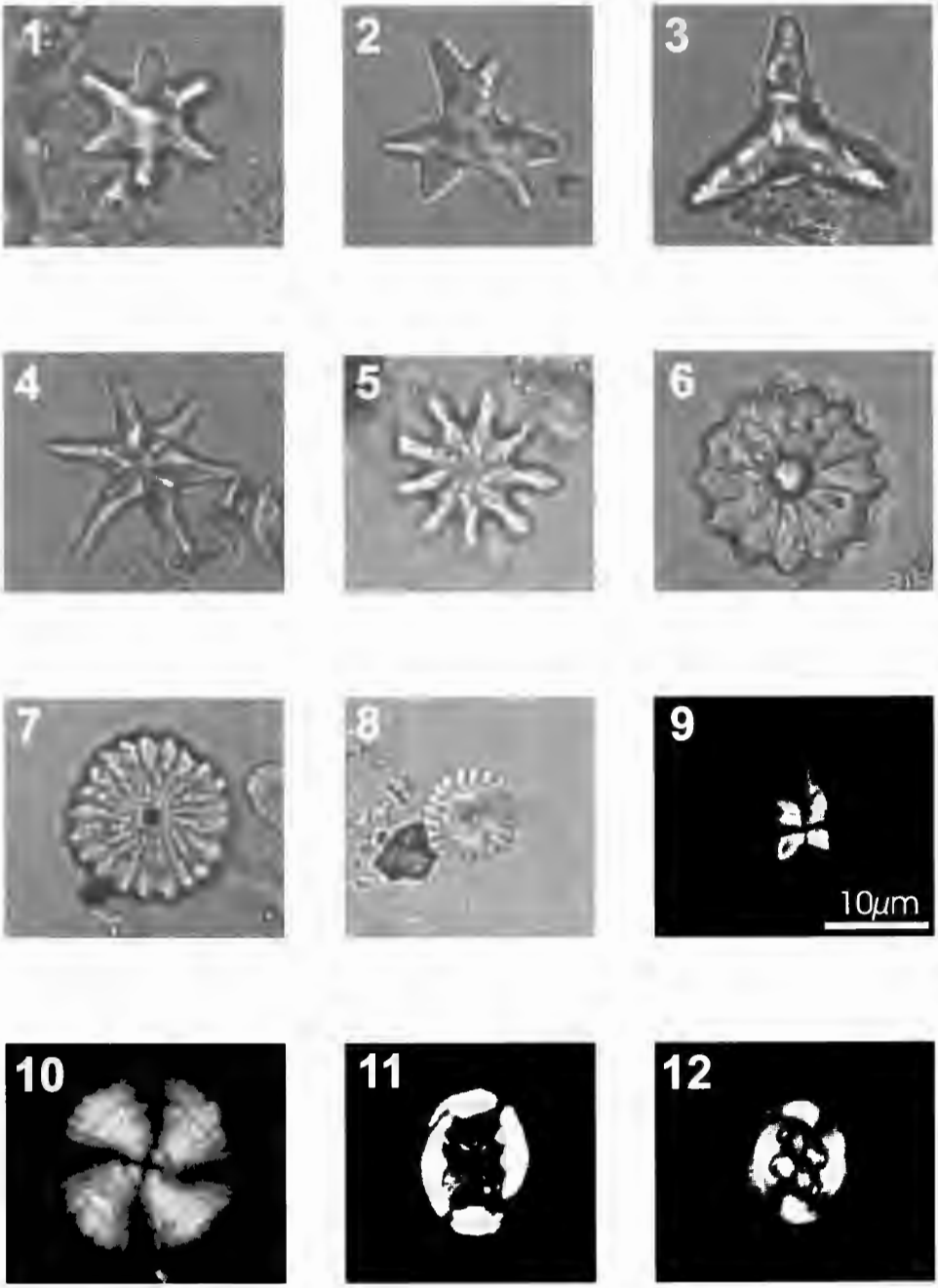


Fig. 2: Chronostratigraphic chart of nannofossil standard zones (NP) and planktic foraminifera zones (P) of the Paleocene to middle Eocene based on BERGGREN et al. (1995) and the correlation of the youngest strata (lower part of NP12) within the Gams section. The Paleocene/Eocene boundary still awaits a clear definition and is indicated by a shaded interval.

Plate 1

LM photographs of biostratigraphically important calcareous nannoplankton species of the lower Eocene of the Gams area. All Figures have the same scale of Fig. 9.

Fig. 1: *Tribrachiatus bramlettei* (sample GAM80/7)
Fig. 2: *Tribrachiatus contortus* (sample GAM80/7)
Fig. 3: *Tribrachiatus orthostylus* (type B) (sample GAM80/1)
Fig. 4: *Discoaster lodoensis* (sample GAM80/1)
Fig. 5: *Discoaster binodosus* (sample GAM80/7)
Fig. 6: *Discoaster barbadiensis* (sample GAM80/1)
Fig. 7: *Discoaster multiradiatus* (sample GAM80/7)
Fig. 8: *Discoaster lenticularis* (sample GAM80/7)
Fig. 9: *Sphenolithus radians* (sample GAM80/1)
Fig. 10: *Heliolithus kleinpellii* (sample GAM80/5)
Fig. 11: *Chiasmolithus expansus* (sample GAM80/1)
Fig. 12: *Cruciplacolithus latipons* (sample GAM80/5)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KOLLMANN, 1964) within a sequence of thin-bedded high-frequent mudturbidites almost without intervening hemipelagic layers (EGGER, unpubl.). This facies is different from other outcrops of that stratigraphic level in other Gosau basins. For example a marly sequence with bentonite-layers which are interpreted as ash of air-fall derivation is described from the Untersberg area near Salzburg (EGGER et al., 1996).

In the present survey the upper part of Zone NP10 could be found in sample GAM80/ 7: The co-occurrence of *Tribrachiatus contortus* (STRADNER) and *Tribrachiatus bramlettei* is indicative for the lower part of Subzone NP10d (AUBRY, 1996). Beside abundant discoasterids (*D. multiradiatus* BRAMLETTE & RIEDEL, *D. binodosus* MARTINI, *D. barbadiensis* TAN, *D. lenticularis* BRAMLETTE & SULLIVAN, *D.*cf. *mohleri* (BUKRY & PERCIVAL), *Chiasmolithus bidens* (BRAMLETTE & SULLIVAN), *Chiasmolithus consuetus*, and *Zygrhablithus bijugatus* DEFLANDRE are common elements of this nannofossil assemblage whilst *Ellipsolithus macellus* (BRAMLETTE & SULLIVAN) and *Ellipsolithus distichus* (BRAMLETTE & SULLIVAN) are scarce. The rare occurrence of species of the genus *Ellipsolithus* is interesting as in the coeval sediments of the Rhenodanubian Flysch zone (EGGER et al., 2000b) specimens of this genus are common.

The lower boundary of Zone NP11 is defined (MARTINI, 1971) by the last occurrence of *Tribrachiatus contortus*. This zone is represented in sample GAM80/6 where *Tribrachiatus orthostylus* SHAMRAI is common without *T. contortus*. Specimens with distinct bifurcation (Type A) could be observed as well as specimens without bifurcation (Type B; see Pl. 1, Fig. 3). In addition to the zonal marker species, *Discoaster multiradiatus*, *D. binodosus*, *D. barbadiensis* are characteristic elements of the nannofossil assemblage. Specimens of *Tribrachiatus bramlettei*, *Arkhangelskiella cymbiformis*, *Broinsonia parca*, *Micula decussata*, *Campylosphaera eodela* BUKRY & PERCIVAL, and *Heliolithus riedelii* BRAMLETTE & SULLIVAN indicate a more pronounced reworking of older deposits. However, the redeposited fossils constitute less than 1% of the total assemblage.

Within sample GAM 80/ 4 no specimens of *Tribrachiatus orthostylus* (Type A) could be observed whilst *Tribrachiatus orthostylus* (Typ B) is still common and the same *Discoaster* species as in GAM80/6 occur but in lesser abundance. This sample can be assigned to the upper part of Zone NP11.

The most diverse and abundant nannofossil assemblages were found in 3 samples (GAM80/1,2,3) from an outcrop of gray and red shales at the forest road to the Eichmayralm. In these samples common specimens of *Discoaster lodoensis* BRAMLETTE & RIEDEL co-occur with *Tribrachiatus orthostylus* (Type B) indicating Zone NP12. Other common species are *D. barbadiensis*, *Sphenolithus radians* DEFLANDRE (Pl.1, FIG. 9), *Chiasmolithus bidens*, and *Zygrhablithus bijugatus*. *Discoaster multiradiatus* is very rare. The absence of species of the genus *Reticulofenestra* indicates a stratigraphic position in the lower part of Zone NP12.

Sample GAM110 from a tectonic window SSW of Bachler contained also a moderately preserved assemblage of Zone NP12, with both *Discoaster lodoensis* and *Tribrachiatus orthostylus* present.

4. DISCUSSION

Our study shows that nannofossil standard Zones NP6 to NP12 occur in the sections near Kronsteiner-Grafenalm of the Gosau Group of Gams. STRADNER (pers. comm.)

indicated the presence of zones NP1 to NP5 above the K/Pg-boundary section of the nearby Knappengraben (Fig. 1; LAHODYNSKY, 1988). Therefore, a complete Paleocene-lower Eocene section seems to be present in the area of Kronsteiner – Knappengraben – Grafenalm, which attains a thickness of approximately 500 m.

Nannofossil assemblages of the youngest sediments of the Gosau Group of Gams indicate the lower part of nannofossil standard Zone NP12, based on the occurrence of *Tribrachiatus orthostylus* and *Discoaster lodoensis* and the absence of species of the genus *Reticulofenestra*. This gives evidence for an Early Eocene (Ypresian) age for these deposits, corroborating the foraminiferal data by WICHER (1956) and KOLLMANN (1963, 1964). The assemblage of planktonic foraminifera found by KOLLMANN (1964) in the youngest deposits of Gams (his "PaleozänIIIb") contains *Morozovella aequa* (CUSHMAN & RENZ), *M. formosa gracilis* (BOLLI) and *M. subbotina* MOROZOVA ("*Globorotalia rex* MARTIN" of KOLLMANN, 1964:117), which indicates the *Morozovella subbotina* Zone of TOUMARKINE & LUTERBACHER (1985) and standard Zone P6 of BERGGREN et al. (1995).

Similar nannofossil assemblages are known from Eocene sediments of the Schorn area (Hackergraben; WILLE-JANOSCHEK, 1966) near the type locality of Gosau, where Lower Eocene deposits contain nannofossil assemblages of Zones NP11 and NP12 (HEKEL, in WILLE, 1968; EGGER, unpubl.). There in the lower part of Zone NP12 thin-bedded turbidites were deposited which are overlain by a pelitic sequence similar to that described here. At Schorn the preserved thickness of Zone NP12 is approximately 150 m.

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